

Research Strategies to Control Ticks on White-tailed Deer

Host-targeted Control of Field Populations of Blacklegged
and Lone Star Ticks to Reduce the Risk of Tick-borne
Disease Transmission

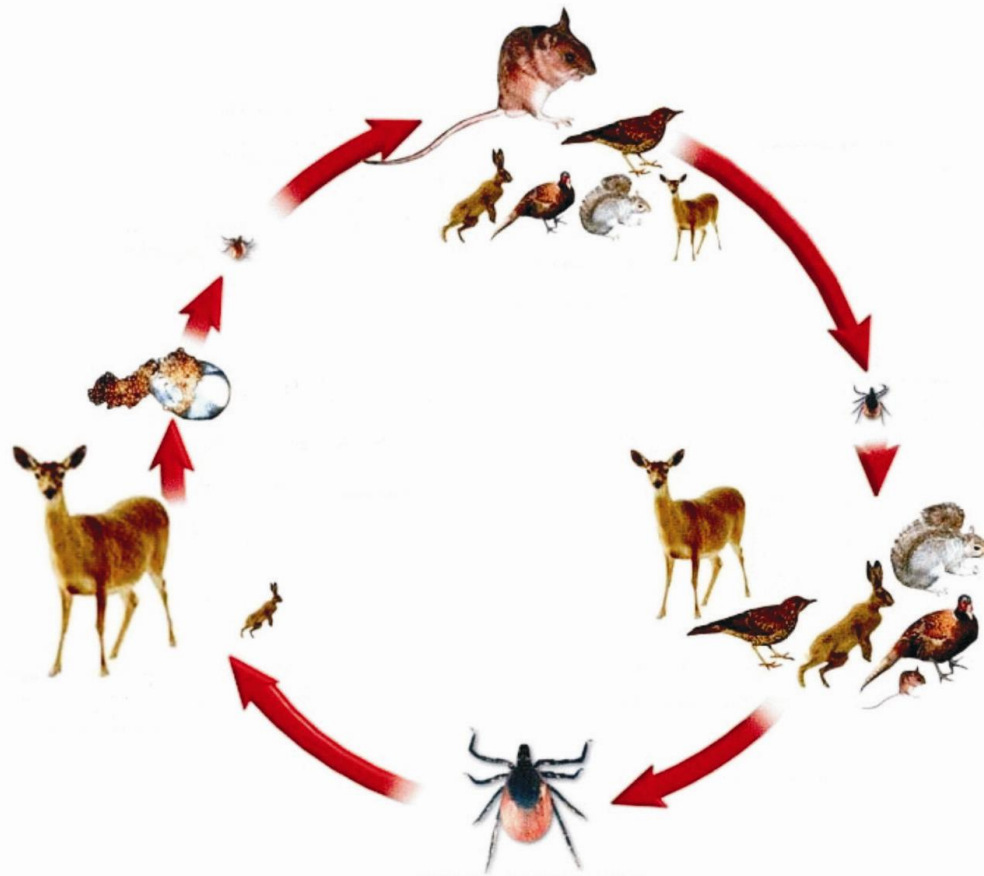
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Promoting Community IPM for Preventing Tick-Borne Diseases
March 31, 2011
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Importance of White-tailed Deer in the Life Cycle of Blacklegged Ticks



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Host-Targeted Control of Ticks on Deer

- **Objective:** Primarily to prevent the successful feeding of adult ticks on white-tailed deer to effectively remove them as a source of blood and interrupt the tick life cycle. In addition, control of larval and nymphal ticks increases overall efficacy.



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Methods of Preventing Ticks from Feeding on Deer

- **Depopulation or density reduction of deer herds**
 - ***Capture (trap or anesthetize) and transport*** - Expensive, difficult to find acceptable relocation site
 - ***Dispatch and donate*** - Less expensive, objections from the public
 - ***Immuno-contraception*** – GonaCon™ - Expensive, labor intensive, and very slow efficacy, long term effects on densities not known
- **Anti-tick vaccines for deer – several labs involved**
 - ***None presently available***
 - Delivery by injection or ingestion
 - ***Lessons from anti-tick vaccines for cattle fever ticks***
 - Only injectable formulations are available thus far – as labor intensive as immuno-contraception of deer
 - Efficacy in cattle of 30 to 85% control – not known for deer
 - Frequent (6 month) re-inoculations required

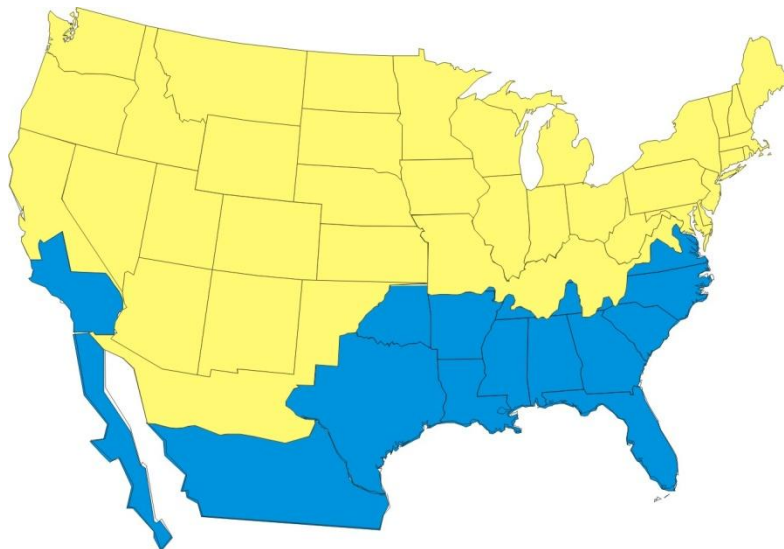


Methods of Preventing Ticks from Feeding on Deer

- **Potential chemical tick control agents**
 - ***Systemically active acaricides*** – *Macrocyclic lactones (ivermectin, doramectin, moxidectin, etc.)*
 - Topical application – Pour-on formulations (Little residual activity)
 - Injectable application – Injectable formulations (Labor intensive)
 - Oral application – Medicated baits such as whole kernel corn (Selective feeding required)
 - ***Topically active acaricides***
 - Pyrethroids - Permethrin, cypermethrin, cyhalothrin, etc. (Long residual activity)
 - Formamidines – Amitraz (Highly efficacious against ticks, long residual activity)
 - Macrocyclic lactones – Ivermectin, etc. (Little residual activity as topical)
 - Organophosphates – Coumaphos, etc. (Limited use - being taken off the market)
 - Phenylpyrazoles – Fipronil, etc. (Highly efficacious, not for use on food animals)
 - Neonicotinoids – Imidacloprid (Efficacious against fleas, does not kill ticks)
 - And perhaps others

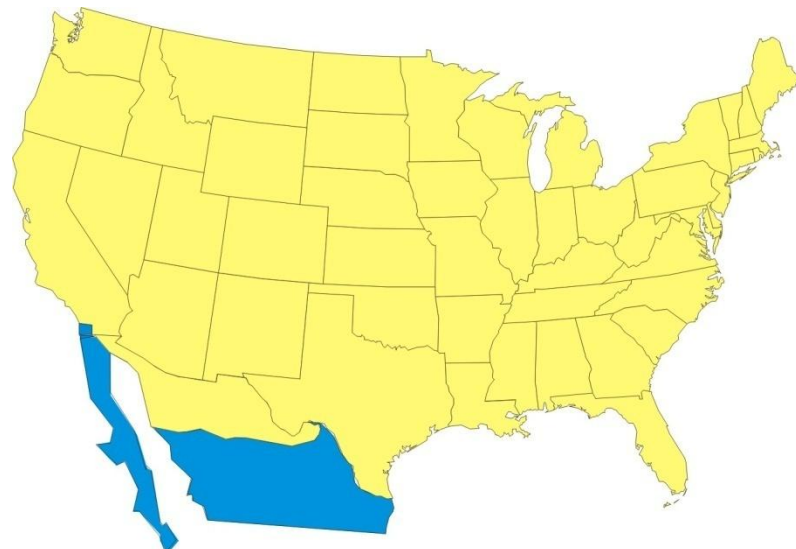


Boophilus spp. Tick Infestations



1906

Beginning of National Campaign



1943

National Eradication Campaign
Complete



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Acaricide Delivery Technologies Developed for White-tailed Deer

- **Delivery of systemically active acaricides**
 - ***Medicated bait***
 - Ivermectin-medicated whole kernel corn
- **Delivery of topically active acaricides**
 - ***'4-Poster' Deer Treatment Bait Stations***
 - Applying Y-Tex '4-Poster' Tickicide (10% oily formulation of permethrin)
 - ***'2-Poster' Deer Treatment Feeder Adapters***
 - Also applying Tickicide
 - ***Automatically attached acaricidal deer collars (neckbands)***
 - Applying long-lasting slow-release collars impregnated with 9% amitraz



Whole Kernel Corn as a Bait and Dosing Medium for White-tailed Deer

- When in the presence of abundant natural forage, white-tailed deer will consume only ca. 1 to 1.5% of body weight per day in whole kernel corn, i.e. a 100 pound deer will consume only ca. 1 to 1.5 pounds of corn daily.
- Unlike cracked corn or pelleted feeds very clean whole kernels are resistant to uptake of moisture and thus do not mold as rapidly in an outdoor environment.
- Whole kernels have minimal surface area as compared with cracked corn or pelleted feeds which makes them easier to coat with liquid formulations.
- Corn is only ca. 7 to 9% protein so it does not increase population densities in deer that require a minimum of 10 to 13% dietary protein.



Systemic Acaricide Technology: Ivermectin-medicated Whole Kernel Corn

- Ivomec Pour-on[®] mixed with re-cleaned whole kernel corn at 2ml per pound of corn
- Re-bagged and fed to deer at ca. 1 pound medicated corn per cwt deer per day (ca. 1% body wt per deer per day)
- Should result in ca. 30 ppb ivermectin in blood serum
- 8 to 10 ppb in serum controls 100% of ticks feeding on deer



Medicated-Bait Field Trials

- **Kerr Wildlife Management Area, Hunt, TX**
 - After 3 seasons of treatment achieved 92, 93, and 100% control of free-living adult, nymphal, and larval lone star ticks.
- **Fairfield Glade, TN**
 - White-tailed deer within a large housing development were fed ivermectin-medicated corn, and residents were so pleased with reduced tick densities that they elected to fund continued treatment of deer after research terminated.
- **Apache Ranch, Webb County, TX**
 - In 1992, an elk herd was selectively fed ivermectin-medicated corn on this 6,500 acre ranch, and a cattle fever tick infestation was successfully eradicated for the first time since 1956.
- **Catarina Ranch, Webb County, TX**
 - Beginning in 1996, white-tailed deer on 22,000 acres of the 40,000 acre ranch were treated with over 22 tons of ivermectin-medicated corn, and in 1997 a cattle fever tick infestation lasting over 90 years was eradicated for the first time ever on record.



Topical Control of Ticks (10% Permethrin) '4-Poster' Deer Treatment Bait Stations



Impact of the '4-Poster' for Control of Ticks on White-tailed Deer at the Kerr Wildlife Management Area



- **Left** – A white-tailed deer from the 96-acre Control Pasture showing a normal lone star tick infestation
- **Right** – A white-tailed deer from the 96-acre Treatment Pasture showing the efficacy of oily 2% amitraz passively applied using a single '4-Poster' Deer Treatment Bait Station

'4-Poster' Deer Treatment Bait Station Trials

- **Kerr Wildlife Management Area, Hunt, TX**
 - *After 3 seasons of treatment achieved 94, 92, and 88% control of free-living adult, nymphal, and larval lone star ticks using an oily 2% formulation of amitraz.*
- **USDA Northeast Area-wide Tick Control Project – MD, NJ, NY, CT, and RI**
 - *After 5 years of treatment achieved 60 to 82% control (meta-analysis of 71% for the entire project) of blacklegged ticks using an oily 2% formulation of amitraz.*
- **Goddard Space Flight Center, Greenbelt, MD**
 - *After 3 years of treatment, achieved 98% control of free-living nymphal blacklegged ticks. As a result of this high degree of efficacy, Goddard Space Flight Center elected to expand the treatment area and continue treatments.*

Cylindrical Feed Chute Deer Feeder with ARS '2-Poster' Treatment Adapter



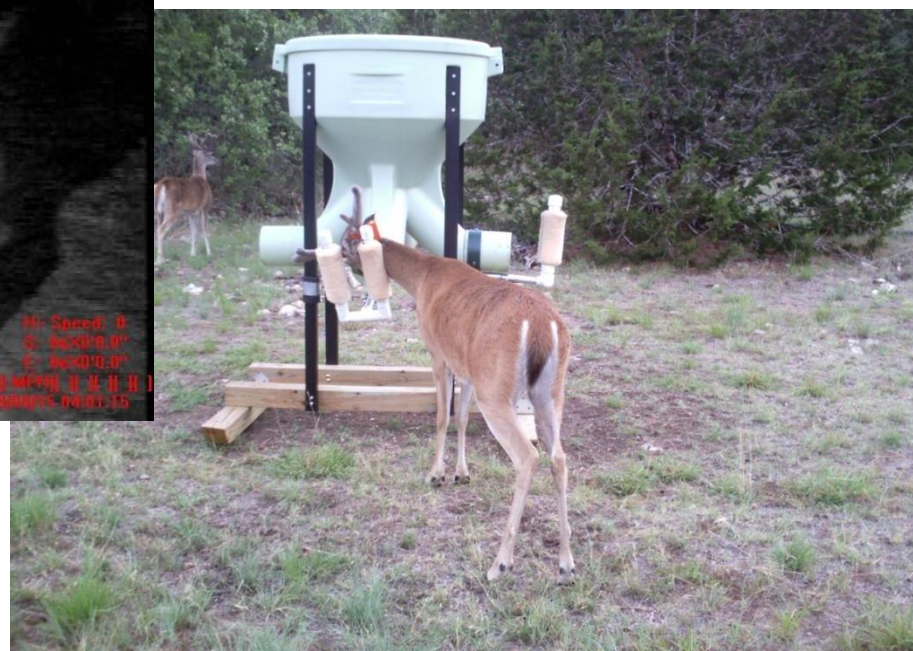
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The '2-Poster' Deer Treatment Feeder Adapter



For use on new or existing feed chute type deer feeders



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Amitraz Collars Applied to White-tailed Deer Effective in Reducing Free-living Populations of Lone Star Ticks



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Functions of the Automatic Deer Collaring Device

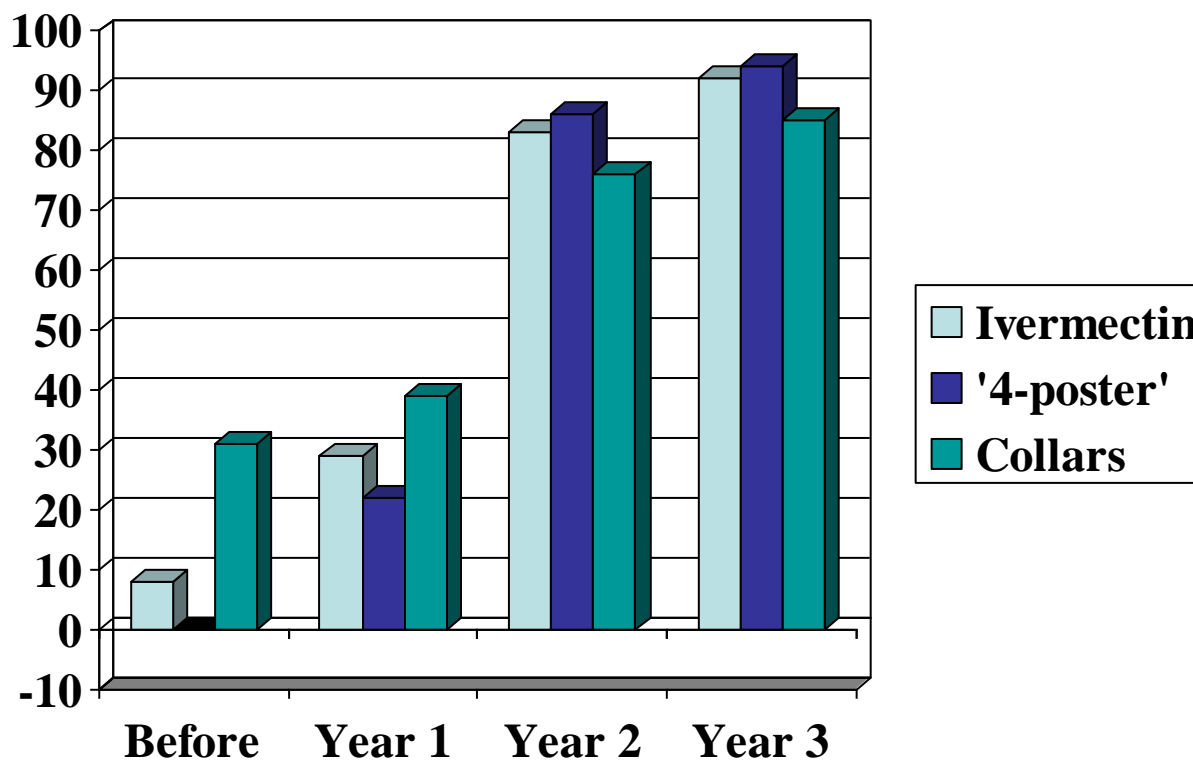
- **At initial entry of deer into feed area of collaring device**
 - *Senses and individually identifies previously collared deer vs. those without collars by reading RFID tags on collars*
 - *Senses the presence of un-collared “deer-shaped” animals*
 - *Senses body position and automatically applies collars to properly positioned deer*
 - *Automatically sizes collars to individual deer during application*
 - *Automatically reloads the next collar from magazine onto collaring arms*
 - *Records video and still photos of each deer to correlate with RFID tag on attached collar and later identify sex and approximate age of deer.*
 - *Automatically records weight and height at withers of deer being collared*
- **At subsequent visit of previously collared deer**
 - *Programmable to automatically inject specific deer*
 - *Programmable to automatically detach collars from specific deer*

The 5th Generation Robotics, Electronics, and Computer Enabled Automatic Collaring Device for White-tailed Deer



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Efficacy of Host-Targeted Technologies to Reduce Free-living Populations of Lone Star Ticks



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Interference from Non-Target Animals

- The most important non-target animals that interfere with deer treatments are raccoons, feral hogs, bear, and squirrels
 - *As hosts for immature ticks, raccoons that are treated topically while accessing '4-Posters' have a positive effect on reducing tick densities. Other non-target animals have negative effects on efficiency and success of the '4-Poster' and other treatment technologies*





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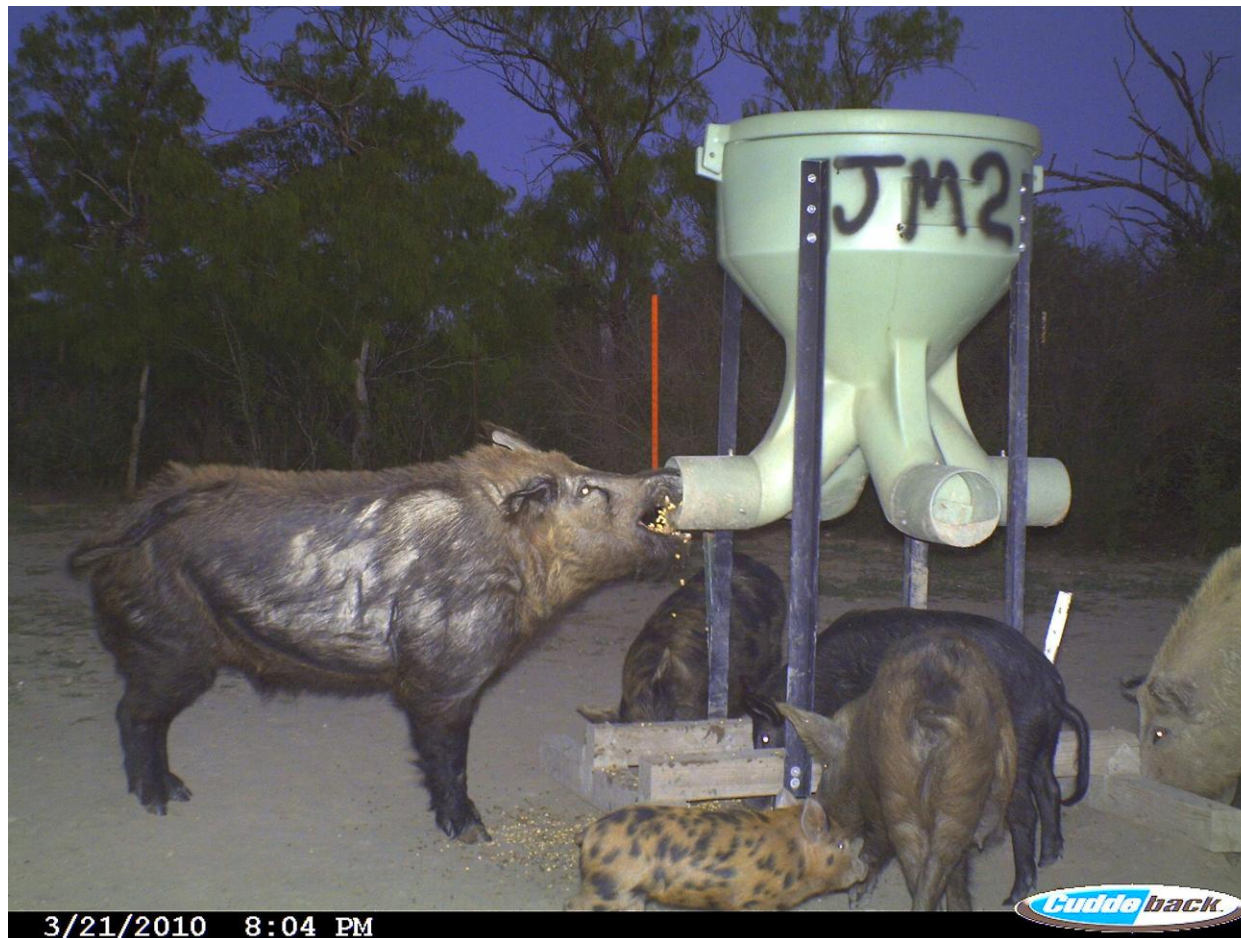
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Hogzilla...



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A Solid Steel “Bear-Proof” 4-Poster



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Bear-Proof ? The first night...



Non-target Animal Excluder Fence

- **Low (24 inch) 30-foot diameter circular utility panel and garden hose topped fence with 3 electric fence wires and supported by short T-posts**
 - *Excludes feral hogs and almost all raccoons*
 - *Permits access by fawns, yearlings, and adult deer*
 - *More expensive than non-electrified fence*
 - *Easy to step over to service feeders*



Hog and Raccoon Excluder Fence



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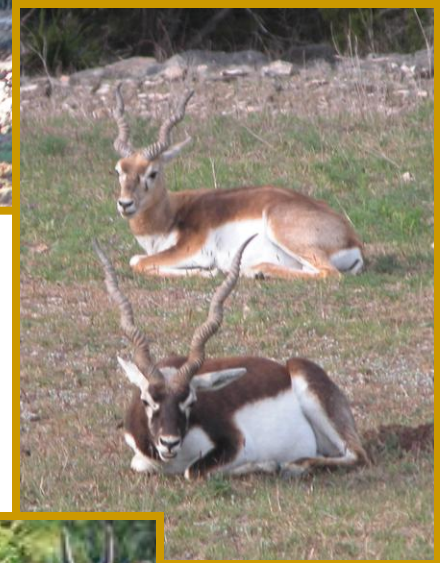


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Fence charger lasts 4 to 6 months on 4 D-cells





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Relative Toxicity – LD50 to Rats

(LD50=Dose that is lethal to 50% of the rats. Larger values are less toxic)

- *Permethrin (10%) = >5050 mg/kg oral*
 - *Roundup (herbicide) =>5000 mg/kg oral*
 - *Picaridin (insect repellent) = 4743 mg/kg oral*
 - *Sodium bicarbonate (baking soda) = 4220 mg/kg oral*
 - *Sodium chloride (table salt) = 3000 mg/kg oral*
 - *Deet (28%) (insect repellent) = 2000 mg/kg oral*
 - *Ultra Downy (fabric softener) = 2000 mg/kg oral*
 - *Imidacloprid (10%) (insecticide) = 1943 mg/kg oral*
 - *Amitraz (100%) (insecticide) = 800 mg/kg oral*
 - *Fipronil (1%) (insecticide)= 750 mg/kg oral*
 - *Tylenol (pain reliever) = 714 mg/kg oral*
 - *Ibuprofen (pain reliever)= 636 mg/kg oral*
 - *Aspirin (pain reliever)= 200 mg/kg oral*
 - *Ivermectin (endecticide) = 50 mg/kg oral*
- **Note: Permethrin fed to rats at 150 mg/kg/day for 6 months = No observable effect**